

## Gone but not forgotten: The status of the Stuttering Frog *Mixophyes balbus* in Victoria

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### Abstract

The Stuttering Frog, *Mixophyes balbus*, is a threatened species restricting to upland streams in coastal drainages of southeastern Australia. There have been no confirmed sightings of this species in Victoria since 1983 and it has suffered marked declines throughout its range. We undertook surveys targeting suitable habitat throughout the potential Victorian extent of range of the species, in order to detect any remaining populations and ascertain its current conservation status. Nineteen stream reaches on 12 different streams were sampled with a total of 41.7 km of watercourse searched. No Stuttering frogs were detected, but all other frog species expected to be associated with streams in the area were frequently detected. These findings build on previous evidence that the Stuttering Frog has declined throughout its range, and may in fact now be extinct in the wild in Victoria. (*The Victorian Naturalist*, 131 (3), 2014, 64–71)

**Keywords:** amphibian declines; extinction; chytrid fungus; conservation assessment

### Introduction

Amphibian population declines, both in Australia and worldwide, have received much attention over the past 25 years (Stuart *et al.* 2004). Within Australia, since the late 1970s at least three species may have become extinct and a further 37 species have undergone population declines and range contractions warranting Red listing by the IUCN (Hero *et al.* 2006). Many of these declines have occurred within protected areas or in other areas where anthropogenic disturbances have been minimal (Stuart *et al.* 2004).

In the late 1990s a novel pathogen, the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (Bd), was discovered (Berger *et al.* 1998), and has since been implicated as a major cause of amphibian declines, particularly for so-called enigmatic declines in minimally disturbed areas (e.g. Lips *et al.* 2006). However, habitat loss and alteration, along with other threatening processes, such as invasive species and pollution, have played important roles in the declines of many species (Gillespie *et al.* 2011). More recently, evidence is mounting that climate change is also adversely affecting some species and communities (Laurance 2008; Bickford *et al.* 2010).

The Stuttering Frog (or Southern Barred Frog) *Mixophyes balbus* (Fig. 1) occurs in riv-

ers along the eastern fall of the Great Dividing Range from north-eastern New South Wales to the Cann River catchment in eastern Victoria (Gillespie and Hines 1999). Historically *M. balbus* was widespread in central and northern NSW and considered secure (Gillespie and Hines 1999). During the 1980s and 1990s, the species underwent a noticeable decline across much of its distribution (Mahony 1993; Gillespie and Hines 1999). Although there were fewer historic records south of Sydney and only three from Victoria (Gillespie and Hines 1999; NSW Wildlife Atlas), the species has now disappeared from nearly all known historical sites in those regions (Lemckert *et al.* 1997; Daly 1998; Gillespie and Hines 1999; Daly *et al.* 2000). Targeted surveys have detected the species at only three localities in NSW south of Sydney in the past 10 years (Daly *et al.* 2000; White 2000; Hunter 2001; Hunter unpublished data).

*Mixophyes balbus* was last seen in Victoria in 1983 (Gillespie and Hines 1999). General fauna surveys in East Gippsland conducted since the 1980s did not locate this species (see Lugg *et al.* 1993); however, there was relatively limited survey effort targeting cryptic amphibian species such as *M. balbus* (G. Gillespie pers. obs.). Additional, more targeted surveys since the mid-1990s have also failed to locate any



Fig. 1. The Stuttering Frog *Mixophyes balbus*. Photo: G Gillespie

individuals (Holloway and Osborne 1996; G. Gillespie unpubl. data).

*Mixophyes balbus* is currently listed nationally as Vulnerable (*Environment Protection and Biodiversity Conservation Act (EPBC) 1999*). In Victoria *M. balbus* is registered as a threatened taxon by the Victorian *Flora and Fauna Guarantee Act 1988* (FFG), and listed as Critically Endangered on the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2013). A National Recovery Plan for *M. balbus* has been published (Hunter and Gillespie 2011), and the Department of Environment and Primary Industries (DEPI) has drafted a Flora and Fauna Guarantee Action Statement for this species (DSE 2009).

Knowledge of the former distribution of *M. balbus* in Victoria is very limited since there was minimal survey effort for riverine frogs in the region before the recognition of decline. Furthermore, the species is highly cryptic, and may remain undetected at low population densities in poorly surveyed areas. New information acquired in recent years on survey techniques for rare stream-breeding frogs suggests that previous sampling effort may have been inadequate (e.g. Gillespie and Hollis 1996; Gillespie 1999; D Hunter unpubl. data). In particular, insufficient lengths of stream were surveyed and there was a lack of survey focus on larvae. Consequently, many parts of the species' southern range may not have been adequately sampled. We undertook targeted surveys of selected catchments in

East Gippsland in an attempt to find any extant populations of *M. balbus* in Victoria, and to reassess its status.

#### Methods

The survey focused on the greater catchments of the Cann and Genoa Rivers, because *M. balbus* is historically known from these catchments, both in Victoria and NSW. One site was also sampled in the Bemm River catchment, west of the Cann River. Sampling sites were selected from satellite imagery and topographic maps. Sites that were likely to meet the following criteria were chosen:

- Streams typically perennial;
- Well developed riparian wet forest or rainforest;
- Steep-sided banks rather than wide terraces;
- Stream beds wider than 1 m;
- Streams with gravel/stony or rocky substrates;
- Up-stream of road crossings.

The first four criteria reflect the typical features of many of the sites at which *M. balbus* persists in NSW. The last criterion favours sites that have relatively low historic disturbance levels. Two historic sites were also re-sampled; Tenynson Creek and Flat Rock Creek (Cann River East Branch) near the NSW border. The third historic site, Jones Creek, was not investigated because advice from David Cameron (Botanist, Arthur Rylah Institute, DEPI) suggested that, as a result of the 1983 fire and subsequent erosion, this catchment has undergone significant geophysical, hydrological and floristic changes,

such that *M. balbus* is unlikely to persist there.

Surveys were undertaken between 19 November 2011 and 23 January 2013. All sampling was undertaken in the months of September to January. Each stream was searched during the day by two or more people walking slowly upstream in the watercourse searching for tadpoles and egg nests. Flat-bottomed dip nets (bag  $\geq 35$  cm wide  $\times$   $\leq 60$  cm deep, mesh size 0.9–4 mm) were periodically swept over the substrate in pools and quieter sections of riffles by one or two observers for approximately 1 to 2 minutes. All tadpoles detected were captured by dipnet and identified (see Hero and Gillespie 1993; Anstis 2002). Egg nests were targeted since *Mixophyes balbus* may breed at this time of the year.

Streams were searched for frogs at night by two or more people walking slowly upstream. *Mixophyes balbus* has a conspicuous eye-shine readily detected with a head torch. Areas both within the stream margins and along banks up to 10 m from the watercourse were searched. Call playback was not used as this was not considered a reliable survey method for this species; however, frog calls were monitored and noted. All frogs located were inspected and identified.

A minimum of 1 km was searched by day and by night at each site. For all surveys hygiene protocols (NPWS 2000) were strictly adhered to in order to minimise the risk of spreading Bd.

### Results

A total of 41.7 km of watercourse was surveyed across 19 stream reaches on 12 different streams (Fig. 2; Table 1). *Mixophyes balbus* was not located at any sites sampled. All other stream-breeding species known from East Gippsland (*Litoria citropa*, *L. lesueuri*, and *L. nudidigitus*) were located along most streams. *Crinia signifera*, *Litoria citropa* and *L. nudidigitus* were abundant at most sites and showed no evidence of population declines since observations made in the 1980s and early 1990s by one of the authors (GG). *Litoria lesueuri* was less common at the sites sampled; however, this species prefers more open forest habitats on wider watercourses in eastern Victoria (Gillespie 2002), and was not expected to be common in the habitats targeted for *M. balbus*. Five other lentic, or facultative stream-breeding, species were also located: *Limnodynastes peronii*, *Litoria aurea*, *L. ewingii*, *L. peronii*, and *L. verreauxii* (Table 1).

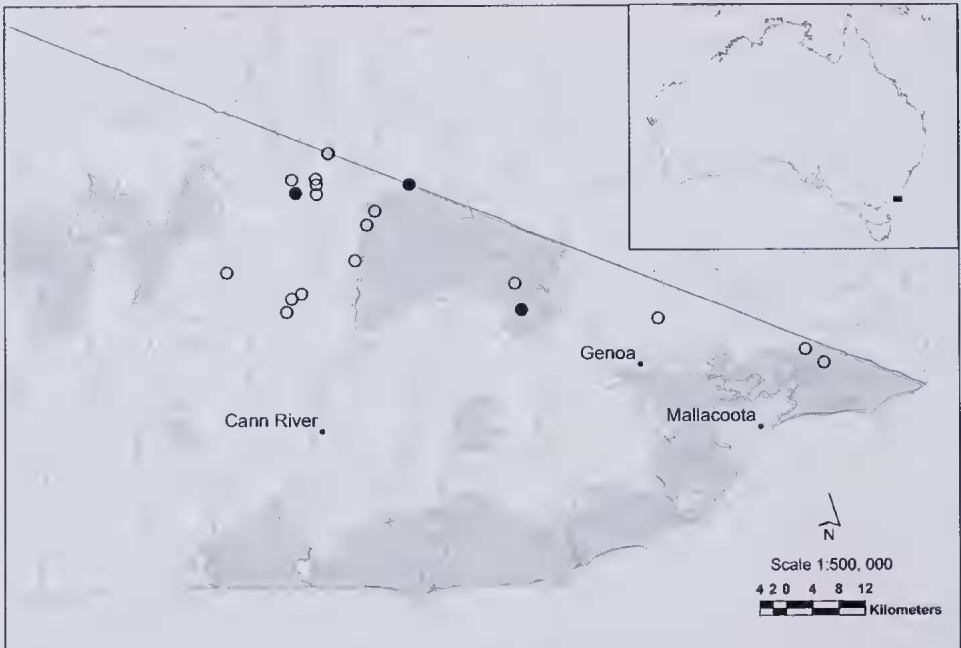


Fig. 2. Known occurrence of *Mixophyes balbus* in Victoria and survey localities. Solid circles = historic *M. balbus* records; open circles = sites other than historic localities surveyed during this study. Shaded areas are national parks.

Table 1. Locations of streams surveyed for *Mixophyes balbus* and species located. \* - denotes historic *M. balbus* localities; S - species seen; H species heard.

Site	Date	Distance sampled (Km)	Number of observers	<i>Litoria aurea</i>	<i>Litoria citropa</i>	<i>Litoria lesueuri</i>	<i>Litoria multidigitus</i>	<i>Litoria ewingii</i>	<i>Litoria peronii</i>	<i>Litoria verreauxii</i>	<i>Crinia signifera</i>	<i>Limnodynastes peronii</i>
Tennyson Ck* 37° 14' 37"; 149° 07' 06"	18/11/2010	3	2	S,H	S,H	S,H	S,H			H		H
Tennyson Ck 37° 13' 29"; 149° 06' 48"	19/11/2010	2.5	2	S,H	S,H	S,H	S,H			H		H
Lockup Ck 37° 24' 18"; 149° 06' 22"	20/11/2010	2.7	2	S,H	S,H	S,H	H					
Cann Swamp Ck 37° 22' 49"; 149° 07' 36"	21/11/2010	2	2	H	H	S	H			H		H
Flat Rock Ck* 37° 13' 51"; 149° 16' 25"	22/11/2010	2	2				H					S,H
Genoa R tributary (Unnamed) 37° 21' 58"; 149° 25' 04"	03/12/2010	4.3	2	S,H	S	S	S,H	S		H		
Dowell Ck 37° 27' 23"; 149° 48' 47"	04/12/2010	3.1	2				H	S,H		H		
Harrison Ck 37° 28' 28"; 149° 50' 20"	05/12/2010	2.1	2	S,H			S,H			S,H		S
Sandy Waterholes Ck 37° 24' 50"; 149° 36' 47"	05/12/2010	2	2	S,H	S	S	S,H			H		

Table 1. (cont.)

Site	Date sampled	Distance (Km)	Number of observers	<i>Litoria aurea</i>	<i>Litoria citropa</i>	<i>Litoria lesueuri</i>	<i>Litoria nudtatigitus</i>	<i>Litoria peronii</i>	<i>Litoria verreauxii</i>	<i>Crinia signifera</i>	<i>Limnodynastes peronii</i>
Buldah Ck 37° 14'40"; 149° 08'50"	05/01/2011	2	3		S		H			H	
Fiddlers Green Ck 37° 17'12"; 149° 12'54"	05/01/2011	2	4		S		H	S		H	
Buldah Ck 37° 11'18"; 149° 09'48"	18/09/2012	1	4							H	
Hensleigh Ck 37° 21' 03"; 149° 01'27"	08/01/2011	2	2	S,H		S,H	S,H				H
Buldah Ck 37° 13'25"; 149° 08'46"	22/10/2011	4	3				H			H	
Chandlers Ck 37° 20' 05"; 149° 11' 58"	19/09/2012	2	2			S	H	S			S,H
Flat Rock Ck 37° 16'02"; 149° 13' 36"	19/01/2013	1	2				S,H		S		H
Lockup Ck 37° 23'13"; 149° 06' 47"	20/01/2013	1	2			S	S,H				H
Buldah Ck 37° 11' 20"; 149° 09'46"	21/01/2013	1	2				H				
Buldah Ck 37° 13' 53"; 149° 08' 49"	23/01/2013	2	2			S	H				H

## Discussion

The present survey builds on previous attempts to locate *M. balbus* in Victoria. The species has not been seen in Victoria for 30 years, and has not been found in NSW south of Eden since the early 1990s (Hunter and Gillespie in review). Urlus and Marr (2011) reported a call record of *M. balbus* from the Thurra River in March 2011; however, this record is considered unreliable and highly doubtful (Clemann and Gillespie 2012). Without doubt, the species has undergone a severe decline throughout the southern part of its range in Victoria and southern NSW.

Available evidence suggests that the most likely cause of decline of *M. balbus* is Bd. The decline coincides with that of many other stream-breeding species in Australia (e.g. Berger *et al.* 1998; Gillespie and Hines 1999), for which Bd has also been implicated. Bd is present in temperate stream systems in eastern Victoria and southern NSW (Krieger *et al.* 2006). Other potential causes of decline, such as habitat loss and alteration (Gillespie *et al.* 2011) or invasive fish species (Gillespie and Hero 1999) can be discounted. Much of the habitat of *M. balbus* within Victoria remains reasonably intact and most of the catchment areas in which *M. balbus* potentially occurs are free of introduced fish predators, such as trout. However, nothing is known about the potential impact of foxes and cats on frog populations, and large terrestrial frogs may be quite vulnerable to predation by these species (Gillespie and Hines 1999).

Climatic factors may also be involved in the decline of *M. balbus*, and may work in concert with Bd (see Pounds *et al.* 2006). However, in the event that climate change leads to increased stream water temperatures, reduced winter stream flows and reduced environmental suitability for Bd, it may in fact favour some stream-breeding amphibians at the southern limits of their subtropical/warm-temperate ranges.

Is *M. balbus* extinct in Victoria? All historic records were made incidentally and apparently with relative ease (M Littlejohn pers. comm.; Museum Victoria records), possibly reflecting relatively higher historical population densities. Subsequent repeated searches (Holloway and Osborne 1996; G Gillespie pers. obs.) have failed to locate the species at historic sites in

Victoria, Tennyson Creek and Flat Rock Creek, or adjacent tributaries with similar habitat. The Flat Rock Creek site appears to have undergone significant habitat changes since the original report, possibly from disturbance associated with improvements to and usage of the adjacent Cann Valley Highway. It seems highly likely that *M. balbus* is extinct at these sites. The intense 1983 forest fire that burnt through the Jones Creek warm temperate rainforest reference area, followed by extensive erosion and subsequent forest regeneration (D. Cameron pers. com.), have almost certainly rendered this historic site unsuitable for *M. balbus*, due to sediment entrainment of the streambed and drastically reduced water flows. Hence it seems highly probable that the species is also extinct in Jones Creek.

The pattern of the historic records strongly suggests that *M. balbus* was more widespread than recent information suggest. The three historic sites have notably different habitats: Flat Rock Creek - Dry Forest, Tennyson Creek - Riparian Forest (through Dry and Damp Forests); and Jones Creek - Warm Temperate Rainforest. Reports in the literature of the species being associated principally with rainforest and wet forest (e.g. Daly 1998; Anstis 2002) undoubtedly reflect observations of the species in northern parts of its range where it was historically most frequently encountered (see Gillespie and Hines 1999). Temperature and suitable breeding habitat are typically the most important factors influencing stream-breeding frog species distribution (Duellman and Trueb 1994). Climatic and biogeographical factors may have limited *M. balbus* to the east of the Bemm River catchment, but its historic elevation range in Victoria and southern NSW (approximately 100-1000 m) suggests that it occupied a large thermal gradient. Suitable breeding habitat for *M. balbus*, comprising predominantly perennial streams, with shallow gravel/stony shoals for egg nests, and lentic pools for tadpole development, occurs within these catchments, and most of the streams we sampled had habitat characteristics that appeared highly suitable for the species. Therefore, historically *M. balbus* may also have been more widespread throughout the tributaries of these catchments than current data indicate.

Holloway and Osborne (1996) undertook a survey of stream-breeding frogs across the potential Victorian range of *M. balbus* but did not locate the species. At that time, knowledge of survey techniques for rare stream-breeding frogs generally, and *M. balbus* specifically, was very limited. We now know that tadpole searches need to be an integral component of *M. balbus* surveys, as this is the most conspicuous life stage of the species. Due to the potential low abundance and highly patchy distribution of this species along watercourses, sampling effort along stream reaches needs to be designed in kilometres rather than metres in order to make any meaningful assessment of the species' status at a site. The present survey addressed these sampling issues, and targeted habitats most likely to favour the species.

In conclusion, *M. balbus* has suffered a substantial decline in both distribution and abundance in Victoria over the past 30 years. It is quite likely that the species is extinct in Victoria; however, this is not certain. Some streams with potentially suitable habitat have not yet been surveyed thoroughly enough to make this assessment with any confidence. In recent years, three Australian amphibian species that had 'disappeared' (Hero *et al.* 2006), and were presumed extinct, have been rediscovered: *Litoria lorica* in the Wet Tropics (Hoskin and Hero 2008); *L. castenea* on the southern Tablelands of NSW (D Hunter unpublished data); and *L. piperata*, a stream-breeding species from northern NSW (S Donnellan South Australian Museum, pers. comm.). In all cases these rediscoveries reflected a previous lack of adequate survey effort, rather than a recovery. Relict populations of other threatened species, including some populations of *M. balbus* in NSW, have persisted despite their vulnerability to Bd. It is therefore possible that remnant populations of *M. balbus* may still persist in Victoria.

East Gippsland has been the stronghold of many of Victoria's threatened amphibian species, including the Giant Burrowing Frog *Heleioporus australiacus*, Green and Golden Bell Frog *L. aurea*, Large Brown Tree Frog *L. littlejohni*, Stuttering Frog *M. balbus*, Martin's Toadlet *Uperoleia martini* and Tyler's toadlet *U. tyleri*. Currently these species are possibly the most poorly known vertebrates in

Victoria. However, with the exception of *L. aurea*, there have been no adequate targeted surveys or ecological studies of them to properly assess their distributions, population status and ecological requirements. Hence the impacts of various potentially threatening processes, and the adequacy of current conservation measures or protected management areas, cannot presently be assessed.

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## Ninety-nine Years Ago

Notes on English and Japanese newts in Victoria

By H. W. Davey, F.E.S.

(Read before the Field Naturalists' Club of Victoria, 14th Dec, 1914.)

With frogs and toads, with one or two exceptions, impregnation of the eggs takes place after they have been extruded by the female, the same as in most of the fishes, but with the tailed Batrachians as newts (*Urodela*) the impregnation of the eggs is usually internal ...

Egg-laying is carried on in much the same manner as with other newts. A female selects some aquatic plant for the purpose—the denser the better—and places a single egg in a fold of a leaf, hiding the egg as much as possible from sight. The necessity for all this care is at once apparent, as the males are most assiduous in their search after eggs, of which food they are extremely fond, and once an egg is discovered in a leaf this is torn and dragged at by the male until at last it can reach the egg, when, with one snap of the jaws, the egg disappears. Both sexes will also greedily devour the young larvae, and it is probably this cannibalistic trait that prompts the female to lay her eggs singly, folded in leaves of waterplants, and the denser these are the better suited for her purpose, as the eggs are better hidden, and greater opportunities for escape are afforded to the newly-hatched larvae.

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